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13. ABSTRACT (Maximum 200 words)

The goal of the research was to understand the role of contextual constraint in the visual analysis of complex, natural scenes. This issue bears directly on the basic architecture of the human visual system, and has implications for the design of artificial vision systems devoted to object and scene analysis. Two hypotheses were considered: (1) Scene constraint influences the perceptual identification of individual objects; (2) Scene constraint influences only post-identification object analysis. The main results of the research support the first hypothesis: Scene constraint does not directly influence perceptual analysis of component objects in human vision. Other results from the research supports the conclusion that semantic information is not used to drive initial eye movements in a scene, but does influence initial fixation time in a region and region refixation probability. Based on these results, a model of scene analysis was developed in which object identification is functionally isolated from scene meaning and gaze control is initially independent of scene semantics but becomes sensitive to meaning as scene perception unfolds over time. Continuing work is currently aimed at testing this model in human vision and gaze control, and implementing an artificial gaze control system on a working robot platform using a Markov Decision Process framework.

14. SUBJECT TERMS
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The main results from the research conducted under this grant are the following:

o Prior demonstrations of facilitated performance for objects that are semantically consistent with their scenes appear to be compromised by a confound in the nature of the control stimulus used to compute measures of perceptual sensitivity (Hollingworth & Henderson, 1997b). Instead, initial perceptual encoding is facilitated for an object that is semantically inconsistent with its scene compared to an object that is semantically consistent (Hollingworth &Henderson, 1998, 1999). This finding is contrary to models of object and scene perception that assume a heavily top-down architecture, but supports models that assume "functional isolation" of object perception, consistent with a modular visual architecture.

o The placement of initial fixations during real-world scene viewing is controlled by visual rather than semantic features, while fixation durations and later fixation placements are controlled by both visual and semantic features (Henderson & Hollingworth, 1998, 1999; Henderson, Weeks, & Hollingworth, 1999). Again, this result is consistent with limited interaction at early stages of scene perception.

o Based on the above findings, as well as other findings in the eye movement literature, we have developed a gaze control model based on a visual saliency map(Henderson & Hollingworth, 1998). We are currently implementing this model on a robot platform using a Markov Decision Process formalism.

o Covert visual-spatial attention facilitates the encoding of perceptual information, in addition to any effects it may have on the reduction of visual noise later in the information processing system (Henderson, 1996).

o The facilitated perceptual encoding of semantically inconsistent objects in scenes is not due to the attraction of covert visual-spatial attention (Hollingworth & Henderson, 1997a). This finding is consistent with our eye movement data showing that covert attention is not attracted to these objects (Henderson, Weeks, & Hollingworth, 1997), and suggests that the engagement of attention is unaffected by semantic consistency (Henderson & Hollingworth, 1998).

o Foveal analysis is not necessary for object identification as long as compensatory time is available for parafoveal analysis (Henderson, McClure, Pierce, & Schrock, 1997). This finding contrasts with reading, in which foveal analysis is necessary for word identification. It will be necessary to determine whether this finding generalizes to full scenes.

o The retention and integration of information about meaningful objects and scenes does not rely on a veridical representation of object contour or object position (Henderson, 1997; Hollingworth & Henderson, 2000). These results are consistent with the view that only abstract representations of complex real-world stimuli are retained and integrated across eye movements.

ARO-Sponsored Scholarly Output

Publications:

Hollingworth, A., & Henderson, J. M. (2000). Semantic informativeness affects the detection of changes in natural scenes. *Visual Cognition (Special Issue on Change Blindness and Visual Memory), 7*, 213-235.

Henderson, J. M., Weeks, P. A. Jr., & Hollingworth, A. (1999). Effects of semantic consistency on eye movements during scene viewing. *Journal of Experimental Psychology: Human Perception and Performance, 25*, 210-228.

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Butler, K. M., Zacks, R. T., & Henderson, J. M. (1999). Suppression of reflexive saccades in younger and older adults: Age comparisons on an antisaccade task. *Memory & Cognition 27,* 584-591.

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Henderson, J. M. (1996). Spatial pre-cues affect target discrimination in the absence of visual noise. *Journal of Experimental Psychology: Human Perception and Performance, 22*, 780-787.

Presentations:

Hollingworth, A., & Henderson, J. M. (May, 1997). Object Identification in scenes: Evidence against schema_driven perception. Presented at the Annual Meeting of the Midwestern Psychological Association, Chicago.

Siefert, A., & Henderson, J. M. (May, 1997). Are object file effects different from absolute position effects? Presented at the Annual Meeting of the Midwestern Psychological Association, Chicago.

Lauwereyns, J., Hollingworth, A., & Henderson, J. M. (May, 1997). Effects of Real_World Scenes on the Control of Visual_Spatial Attention. Presented at the Annual Meeting of the Midwestern Psychological Association, Chicago.

Lauwereyns, J., Hollingworth, A., & Henderson, J. M. (December, 1996). Effects of real-world scenes on the control of visual selective attention. Paper presented at the Department of Psychology, University of Illinois, Urbana-Champaign.

Henderson, J. M., Weeks, P. A., Jr., & Hollingworth, A. (November, 1996). The influence of scene context on object perception. Paper presented at the Annual Meeting of the Psychonomic Society, Chicago.

Henderson, J. M., Weeks, P. A., Jr., & Hollingworth, A. (August, 1996). Object encoding in natural scenes. Paper presented at the International Congress of Psychology, Montreal.

Henderson, J. M., & Hollingworth, A. (July, 1996). The effects of scene context on object perception. Paper presented at the Workshop on Scene Perception, Max Planck Institute for Biological Cybernetics, Tübingen, Germany.

Henderson, J. M. (June, 1996). The effects of scene context on object perception. Paper presented at the Department of Psychology, Free University of Brussels, Brussels, Belgium.

Henderson, J. M. (June, 1996). Complex object and scene perception. Paper presented at the Department of Experimental Psychology, University of Leuven, Belgium.

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Philip A. Weeks, Jr., Ph.D. completed.
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Andrew Hollingworth, M.A. completed, Ph.D. in progress.